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Indian Standard

SPECIFICATION FOR TITANIUM DIOXIDE FOR COSMETIC INDUSTRY

(Second Revision)

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Indian Standard

SPECIFICATION FOR TITANIUM DIOXIDE FOR COSMETIC INDUSTRY

(Second Revision)

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Indian Standard

SPECIFICATION FOR TITANIUM DIOXIDE FOR COSMETIC INDUSTRY

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 27 June 1983, after the draft finalized by the Cosmetics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

0.2 This standard was originally published in 1964 and was subsequently revised in 1978, wherein the requirements were divided in to two groups, essential and optional. Subsequently this was found non-implementable for certification and, therefore, in this revision, only a single set of requirement has been stipulated.

0.3 In cosmetic industry, titanium dioxide is used in the preparation of face powders, depilatories and cold and other creams.

0.4 For matter souble in water, a maximum limit of 0·25 percent has been laid down. The Committee desired this limit to be reduced to 0·15 percent, but in view of the inability of indigenous manufacturers to comply with the lower limit, the higher one has been retained. It is hoped that the indigenous manufacturers will make attempts to improve the product so that it satisfies the cosmetic industry.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS:2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard prescribes the requirements and the methods of sampling and test for titanium dioxide for cosmetic industry.

---

*Rules for rounding off numerical values (*revised*).

2. REQUIREMENTS

2.1 Description — The material shall be in the form of a soft, dry, white powder. It shall be free from grit.

NOTE — The checking freedom from grit, until a reproducible method of test is developed, the following method may be used:

'Take 20 g of the material in a beaker and remove, by overflow under a carefully controlled steady stream of water, a larger portion of the material. The grit being heavier will remain in the beaker along with some titanium dioxide. Test the pasty residue by rubbing between the finger and thumb for the presence of grit'.

2.2 The material shall also comply with the requirements given in Table 1, when tested as prescribed in Appendix A. Reference to the relevant clauses of Appendix A is given in col 4 of the table

TABLE 1 REQUIREMENTS FOR TITANIUM DIOXIDE FOR COSMETIC INDUSTRY

SL No.	CHARACTERISTIC	REQUIREMENT	METHOD OF TEST (REF TO CL NO. IN APPENDIX A)
(1)	(2)	(3)	(4)
i)	Matter soluble in water, percent by mass, *Max*	0·25	A-2
ii)	Titanium dioxide, percent by mass, *Min*	99·0	A-3
iii)	Arsenic (as AS_2O_3), ppm, *Max*	2	A-4
iv)	Heavy metals as (Pb), ppm, *Max*	20	A-5
v)	Volatile matter, percent by mass, *Max*	0·5	A-6
vi)	Residue on 63 micrometre IS Sieve, percent by mass *Max*	0·1	A-7
vii)	*p*H of aqueous extract	6·5 to 8·0	A-8
viii)	Matter soluble in acid, percent by mass, *Max*	0·35	A-9
ix)	Loss on ignition (after drying), percent by mass, *Max*	0·5	A-10

2.2.1 *Colour* — The colour of the material shall be as agreed to between the purchaser and the supplier.

3. PACKING AND MARKING

3.1 Packing — The containers shall be packed as agreed to between the purchaser and the supplier.

3.2 Marking — The containers shall be marked with the following information:

a) Name of the material;
b) Net mass in the container;
c) Name of the manufacturer and recognized trade-mark, if any; and
d) Batch number in code or otherwise.

3.3 BIS Certification Marking

The product may also be marked with Standard Mark.

3.3.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

4. SAMPLING

4.1 Preparation of Test Samples — Representative test samples of the material shall be prepared as prescribed in Appendix B.

4.2 Number of Tests

4.2.1 Test for the determination of titanium dioxide shall be conducted on each of the individual samples (**B-3.1.3**).

4.2.2 Test for the remaining characteristics, namely, colour, volatile matter, residue on 63-micron IS sieve, matter soluble in water, *p*H, matter soluble in acid, loss on ignition, arsenic and heavy metals shall be conducted on the composite sample (**B-3.1.2**).

4.3 Criteria for Conformity

4.3.1 *For Individual Samples* — The mean and the range for the test results for titanium dioxide shall be calculated as follows:

Mean ($\bar{X}$) = sum of the test results divided by the number of test results, and

Range (R) = difference between the maximum and the minimum values of the test results.

4.3.1.1 The lot shall be declared to have satisfied the requirement for titanium dioxide if the value of the expression ($\bar{X} - 0{\cdot}6\ R$) is equal to or greater than 99·0.

4.3.2 *For Composite Sample* — The composite sample shall meet the requirements specified in **2** and in Table 1.

4.3.3 A lot shall be declared as conforming to this specification if it satisfies the requirements for each of the characteristics specified in **2** and Table 1. If the requirements for any of the characteristics are not met, the lot shall be declared to have not satisfied the requirements of the specification.

APPENDIX A

(*Clause* 2.2)

METHODS OF TEST FOR TITANIUM DIOXIDE FOR COSMETIC INDUSTRY

A-1. QUALITY OF REAGENTS

A-1.1 Unless specified otherwise, pure chemicals and distilled water (*see* IS : 1070-1977*) shall be used in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

A-2. DETERMINATION OF MATTER SOLUBLE IN WATER

A-2.1 Reagent

A-2.1.1 *Ammonium Chloride Solution* — 2 percent.

A-2.2 Procedure — Dry about 12 g of the material as prescribed in **A-6.1**. Weigh accurately about 10 g of the dried material, transfer to a 250-ml beaker, add 50 ml of water and mix thoroughly. Allow to stand overnight. Transfer the contents of the beaker to a 200-ml volumetric flask, add 10 ml of ammonium chloride solution and mix thoroughly. If the material does not settle, add another 10 ml of ammonium chloride solution. After the matter has settled, add water to the mark. Mix thoroughly and filter through double thickness of filter paper (Whatman No. 52 or equivalent). Discard the first 10 ml of the filtrate. Collect 100 ml of the filtrate in a weighed platinum dish and evaporate on a hot-plate. Ignite the residue at dull red heat to constant mass (within 1 mg). Carry out a blank determination. following all the steps given above but omitting the material.

---

*Specification for water for general laboratory use (*second revision*).

A-2.3 Calculation

$$\text{Matter soluble in water, percent by mass} = 200 \frac{(M_1 - B)}{M_2}$$

where

M_1 = mass in g of the residue in the dish in the test with the material,

B = mass in g of the residue in the blank determination, and

M_2 = mass in g of the dried material taken for the test.

A-3. DETERMINATION OF TITANIUM DIOXIDE

A-3.1 Procedure — The determination of titanium dioxide shall be carried out as prescribed in Appendix B of IS:411-1981*.

A-4. DETERMINATION OF ARSENIC

A-4.0 Outline of the Method — The stain obtained on mercuric bromide paper by arsine is compared with a stain obtained with standard arsenic solution.

A-4.1 Reagents

A-4.1.1 *Concentrated Sulphuric Acid — see* IS:266-1976†.

A-4.1.2 *Concentrated Nitric Acid — see* IS:264-1976‡.

A-4.1.3 *Hydrofluoric Acid*

A-4.2 Procedure

A-4.2.1 Weigh 1·000 g of the material in a platinum dish and add 5 ml of concentrated sulphuric acid and 5 ml of concentrated nitric acid. Take to fumes on a hot-plate. Cool and again take to fumes with three successive 5 ml portions of hydrofluoric acid. Cool and dissolve cautiously in water and make up the volume to exactly 100 ml.

A-4.2.2 Carry out the test for arsenic as prescribed in IS:2088-1971§, taking 10 ml of the solution obtained in **A-4.2.1** into a Gutzeit bottle, then adding 20 ml of water, 2 ml of ferric ammonium sulphate solution and 0·5 ml of stannous chloride solution to it. Compare the stain obtained with that produced with 0·000 2 mg of arsenic trioxide (As_2O_3).

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*Specification for titanium dioxide, anatase, for paints (*first revision*).

†Specification for sulphuric acid (*second revision*).

‡Specification for nitric acid (*second revision*).

§Methods for determination of arsenic (*first revision*).

A-5. DETERMINATION OF HEAVY METALS

A-5.0 General

A-5.0.1 *Outline of the Method* — In a solution of the material, iron is masked with citric acid and heavy metals are precipitated as their sulphides in the presence of copper sulphate as a carrier. Lead is reacted, after suitable *p*H control and masking of other heavy metals, with dithizone and, the colour thus developed is compared with that obtained with standard lead solution.

A-5.0.2 Accuracy of the result obtained by the method prescribed depends upon proper *p*H control. Therefore, all vessels used should be scrupulously clean. Water used in the tests should be freshly distilled.

A-5.1 Apparatus — Nessler cylinders of 50 ml and 100 ml capacity.

A-5.2 Reagents

A-5.2.1 *Perchloric Acid* — 60 percent.

A-5.2.2 *Hydrofluoric Acid* — 40 percent.

A-5.2.3 *Citric Acid*

A-5.2.4 *Dilute Ammonium Hydroxide* — 1 : 10.

A-5.2.5 *Copper Sulphate*

A-5.2.6 *Hydrogen Sulphide* — gas

A-5.2.7 *Dilute Nitric Acid* — approximately 1 percent.

A-5.2.8 *Potassium Cyanide Solution* — 10 percent.

A-5.2.9 *Chloroform*

A-5.2.10 *Dithizone Solution* — Dissolve 1 g of commercial dithizone reagent in about 50 ml of chloroform and extract with redistilled ammonium hydroxide (1 : 100) in successive portions of about 75 ml each (the reagent is orange coloured in ammoniacal solution). Combine ammoniacal extracts, acidify with dilute hydrochloric acid (4N) and then extract with chloroform using successive portions of about 20 ml each. A suitable reagent contains from 1 to 10 mg per 100 ml of chloroform and has a green colour.

A-5.2.11 *Standard Lead Solution* — Dissolve 1·600 g of lead nitrate in water and make up the solution to exactly 1 000 ml. Pipette out 10 ml of the solution and dilute it again to 1 000 ml with water. One millilitre of the final solution contains 0·01 mg of lead (as Pb). The solution should be freshly prepared.

A-5.3 Procedure

A-5.3.1 Weigh 2·000 g of the material in a platinum dish and treat with 5 ml of perchloric acid. Take to fumes on a hot-plate with three successive portions of hydrofluoric acid. Cool and dilute with water. Filter the solution, if necessary, with suction through a fine fritted glass filter, catching the filtrate in a 500-ml glass-stoppered conical flask. Dilute to about 200 ml, add 10 g of citric acid and adjust the *p*H to 3·0 to 3·4 by adding dilute ammonium hydroxide (yellow-purple colour with bromophenol-blue indicator). Add about 10 mg of copper sulphate to act as coprecipitant and precipitate sulphides by passing hydrogen sulphide gas until solution is saturated. Allow to settle and filter. Dissolve the precipitated sulphides, without previous washing, with 5 ml of hot dilute nitric acid, drawing the solution through filter into the original flask; wash with hot water and collect the washings along with the solution in nitric acid. Boil to remove hydrogen sulphide. Transfer to a 200-ml separating funnel, add 5 g of citric acid previously dissolved in water, make ammoniacal to get *p*H between 8·5 and 10 (bluish-green to blue with thymol-blue indicator), and add 5 ml of potassium cyanide solution. Immediately extract with successive 20-ml portions of dithizone solution. Combine all dithizone extracts in a Nessler cylinder. Make up the volume with chloroform to 100 ml.

A-5.3.2 Carry out a control test using 4 ml of standard lead solution and the same quantities of other reagents as used in the test with the material.

A-5.3.3 The material shall be taken as not having exceeded the limit prescribed in Table 1 if the intensity of colour produced in the test with the material is not greater than that produced in the control test.

A-6. DETERMINATION OF VOLATILE MATTER

A-6.1 Procedure — Weigh accurately about 2 g of the material in a weighed flat-bottom dish of about 8 cm diameter. Keep the dish with the material in an oven maintained at 105 ± 2°C for two hours. Cool in a desiccator and weigh. Repeat the operation of heating, cooling and weighing until consecutive weighings agree to within 1 mg.

A-6.2 Calculation

$$\text{Volatile matter, percent by mass} = 100 \times \frac{M_1}{M_2}$$

where

M_1 = loss in mass in g on heating, and

M_2 = mass in g of the material taken for test.

A-7. DETERMINATION OF RESIDUE ON 63 MICROMETRE IS SIEVE

A-7.1 Procedure — Weigh accurately about 10 g of the material and transfer it to a 63 micrometre IS seive. Wash the material through the sieve by directing a slow stream of tap water upon it (*see* Note 1). Tapping may be necessary to start the water through the sieve. Continue washing the material until the washings are free from the portion of the material that is fine enough to pass through the sieve (*see* Note 2). Dry the seive containing the residue on a steam bath and finally in an oven at 105 ± 2°C. When dry, carefully brush the residue on to a tared watch glass and weigh accurately.

NOTE 1 — Tap water is usually sufficiently free from suspended particles to be utilized directly as it comes from the faucet. If the water is turbid, it is necessary to place a large bottle of distilled water above the working sink and to siphon the water through a clean rubber tube to the level of the sieve. It is good plan to insert a small rubber stopper carrying a short glass tube about 5 cm in length and 0·6 cm in internal diameter in the faucet outlet. A thin flexible piece of clean rubber tubing (new tubing should first be throughly washed) about 60 cm in length is then attached to the glass tube. The faucet is turned on very slowly until a thin stream of water is coming through the rubber tube. By pressing the end of the rubber tube between the fingers, the stream of water can be varied in intensity and directed to any section of sieve. Experience has shown that the best practice is to tilt and tip the sieve from one side to another alternately, and wash the sample from the higher level of the sieve to the lower.

NOTE 2 — In order to obtain comparable results, it is essential to continue washing the residue on the sieve until one is satisfied that all the material fine enough to pass through the sieve has been removed. At least half an hour of washing is essential in most cases. It is a good plan to catch the last washes in a beaker. By viewing the contents of the beaker against a dark coloured background, it is possible to gauge the progress of the washing operations accurately.

A-7.2 Calculation

$$\text{Residue on 63 micrometre IS sieve, percent by mass} = 100 \times \frac{M_1}{M_2}$$

where

M_1 = mass in g of the residue, and

M_2 = mass in g of the material taken for the test.

A-8. DETERMINATION OF *p*H

A-8.1 Apparatus

A-8.1.1 *pH Meter* — equipped with glass electrodes.

A-8.2 Procedure — Boil about 10 g of the material, accurately weighed, with 50 ml of water for 30 minutes, adding water from time to time to maintain approximately the original volume of the liquid. Cool and filter. Determine the *p*H value of the filtrate within 5 minutes of filtration.

A-9. DETERMINATION OF MATTER SOLUBLE IN ACID

A-9.1 Reagent

A-9.1.1 *Dilute Hydrochloric Acid* — approximately 0·5 N.

A-9.2 Procedure — Weigh accurately about 5 g of the material, dried as prescribed in **A-6**, and add to 100 ml of dilute hydrochloric acid contained in a beaker. Heat on a steam-bath with occasional stirring for half an hour. Filter and wash three times with 10 ml portions of dilute hydrochloric acid. Evaporate the filtrate to dryness and dry in and oven at 105 ± 2°C to constant mass (within 1 mg).

A-9.3 Calculation

$$\text{Matter soluble in acid, percent by mass} = 100 \times \frac{M_1}{M_2}$$

where

M_1 = mass in g of the residue, and

M_2 = mass in g of the dried material taken for the test.

A-10. DETERMINATION OF LOSS OF IGNITION

A-10.1 Procedure — Weigh accurately about 5 g of the material, dried as prescribed in **A-6**, in a porcelain crucible and ignite about 800°C to constant mass (within 1 mg).

A-10.2 Calculation

$$\text{Loss on ignition, percent by mass} = 100 \times \frac{(M_1 - M_2)}{M_1}$$

where

M_1 = mass in g of the dried material taken for the test, and

M_2 = mass in g of the residue.

APPENDIX B

(*Clause* 4.1)

SAMPLING OF TITANIUM DIOXIDE FOR COSMETIC INDUSTRY

B-1. GENERAL REQUIREMENTS OF SAMPLING

B-1.0 In drawing, preparing, storing and handling test samples, the following precautions and directions shall be observed.

B-1.1 Samples shall not be taken in an exposed place.

B-1.2 The sampling instrument shall be clean and dry.

B-1.3 Precautions shall be taken to protect the samples, the material being sampled, the sampling instrument and the containers for samples from adventitions contamination.

B-1.4 To draw a representative sample, the contents of each container selected for sampling shall be mixed as thoroughly as possible by suitable means.

B-1.5 The samples shall be placed in clean, dry, air-tight glass or other suitable containers.

B-1.6 The sample containers shall be of such a size that they are almost completely filled by the sample.

B-1.7 Each sample container shall be sealed air-tight with a suitable stopper after filling, and marked with full details of sampling, the date of sampling and the year of manufacture of the material.

B-2. SCALE OF SAMPLING

B-2.1 Lot — All the containers in a single consignment of the material drawn from a single batch of manufacture shall constitute a lot. If a consignment is declared or known to consist of different batches of manufacture, the containers belonging to the same batch shall be grouped together and each such group shall constitute a separate lot.

B-2.1.1 Samples shall be tested from each lot separately for ascertaining conformity of the material to the requirements of the specification.

B-2.2 The number of containers (*n*) to be chosen from the lot shall depend on the size of the lot (*N*) and shall be in accordance with col 1 and 2 of Table 2.

TABLE 2 NUMBER OF CONTAINERS TO BE SELECTED FOR SAMPLING

LOT SIZE *N* (1)	NUMBER OF CONTAINERS TO BE SELECTED *n* (2)
3 to 50	3
51 ,, 200	4
201 ,, 400	5
401 ,, 650	6
651 and above	7

B-2.3 The containers to be selected for sampling shall be chosen at random from the lot and for this purpose random number tables (*see* IS:4905-1968*) shall be used; in case such tables are not available, the following procedure may be adopted:

> 'Starting from any container, count them 1, 2, 3 ……… …, up to r and so on in a systematic manner, where r is the integral part of N/n. Every rth container thus counted shall be withdrawn from the lot, till the requisite number of containers required for sampling are obtained.

B-3. TEST SAMPLES AND REFEREE SAMPLE

B-3.1 Preparation of Test Samples

B-3.1.1 Draw with an appropriate sampling instrument a small portion of the material from different parts of each container selected (*see* Table 2). The total quantity of the material drawn from each container shall be sufficient to conduct the tests for all the characteristics given under **2** and shall be not less than 300 g.

B-3.1.2 Thoroughly mix all portions of the material drawn from the same container. Out of these portions, equal quantity shall be taken from each selected container and shall be well mixed up together so as to form a composite sample weighing not less than 500 g. This composite sample shall be divided into three equal parts, one for the purchaser, another for the supplier and the third as a referee sample.

B-3.1.3 The remaining portion of the material from each container (after the quantity needed for the formation of composite sample has been taken) shall be divided into three equal parts, each part weighing not less than 50 g. These parts shall be immediately transferred to thoroughly dried bottles which are then sealed air-tight with stoppers and labelled with all the particulars of sampling given under **B-1.7.** The material in each such sealed bottle shall constitute an individual test sample. These individual samples shall be separated into three identical sets of samples in such a way that each set has an individual test sample representing each container selected. One of these three sets shall be sent to the purchaser, another to the supplier and the third shall be used as referee sample.

B-3.2 Referee Sample — The referee sample shall consist of the composite sample (**B-3.1.2**) and a set of individual samples (**B-3.1.3**) marked for this purpose and shall bear the seals of the purchaser and the supplier. These shall be kept at a place agreed to between the purchaser and the supplier and shall be used in case of dispute between the two.

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*Methods for random sampling.

(*Continued from page* 2)

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AMENDMENT NO. 1 MAY 1999
TO
IS 2851 : 1983 SPECIFICATION FOR TITANIUM DIOXIDE FOR COSMETIC INDUSTRY

(Second Revision)

(*Page* 7, *clause* **A-3**) — Substitute the following for the existing:

A-3.0 General — Two methods have been stated for determination of titanium dioxide, namely, titremetric and spectrophotometric. However, in case of dispute titremetric method shall be the referee method.

A-3.1 Method A Titremetric Method

A-3.1.1 *Outline of the Method* — Titanium is determined by back titration of excess EDTA with standard copper sulphate solution using pyrocatechol violet metal indicator, which forms blue coloured complex with divalent copper atom.

A-3.1.2 *Reagents*

A-3.1.2.1 *Ammonium sulphate*

A-3.1.2.2 *Concentrated sulphuric acid*

A-3.1.2.3 *Strong ammonia solution*

A-3.1.2.4 *EDTA*— 0.05M standard solution

A-3.1.2.5 *Pyridine*

A-3.1.2.6 *Copper sulphate* — 0.05 M solution.

A-3.1.2.7 *Pyrocatechol violet indicator* (0.1 percent aqueous solution)

A-3.1.3 *Procedure*

Weigh accurately about 0.3 g of TiO2 and transfer to Kjeldhal Flask. Add 20 ml of sulphuric acid and 8 g of ammonium sulphate. Mix and heat until white fumes appear; continue heating over a strong flame until solution is effected. Cool and carefully dilute with 100 ml of water. Heat gently and bring to boil with continuous stirring. Cool, filter and wash with several quantities each of 10 ml of water. Combine the filterate and washings, add 10 ml of strong ammonia solution, cool and dilute to 200 ml with water. (Ensure fresh strong ammonia solution).

Pipette 20 ml of the solution into a conical flask and add 25 ml of standard EDTA solution. Dilute to 100-150 ml and add 3-10 pyridine with stirring. Then add the indicator and titrate with standard copper sulphate solution to deep blue colour. Take a blank reading without test solution.

A-3.1.4 *Calculation*

Each ml of 0.05M EDTA consumed + 0.003 995 g of TiO2

$$\text{percent by mass of TiO2} = \frac{(\text{Bllank-Titre}) \times M \times 0.003\,995 \times 200 \times 100}{0.05 \times 20 \times W}$$

where '*M*' is molarity $CuSO_4$ solution,

'*W*' is weight of substance on dry basis.

A-3.2 Method B Spectrophotometric Method Determination of Titanium Dioxide Substitute

A-3.2.1 *Outline of the Method* — With an acidic Titanium (IV) solution, Hydrogen Peroxide produces yellow colour. The intensity of the colour is proportionate to the amount of Titanium present.

A-3.2.2 *Reagents*

A-3.2.2.1 *Ammonium sulphate*

A-3.2.2.2 *Concentrated sulphuric acid* (*see* IS 266)

A-3.2.2.3 3 *percent hydrogen peroxide solution* — Dilute 10 ml of strong hydrogen peroxide to 100 ml in a standard flask with water.

A-3.2.3 *Procedure*

A-3.2.3.1 *Preparation of standard titanium solution* — Weigh accurately about 0.209 g of standard titanium dioxide (previously dried at 10°C for 3 hours) in a 250 ml beaker. Add 8 g of ammonium sulphate and 20 ml concentrated sulphuric acid. Digest it on a hot plate until a clear solution is obtained. Cool the contents of the beaker and dilute it to 250 ml in a standard flask with water. Pipette out 10 ml of this solution into a 100 ml standard flask and make up to the volume with water.

A-3.2.3.2 *Sample Titanium solution preparation* — Weigh accurately about 0.2 g of the sample in a 250 ml beaker. Add 8 g of Ammonium Sulphate and 20 ml concentrated sulphuric acid. Digest it on a hot plate until a clear solution is obtained. Cool the contents of the beaker and dilute it to 250 ml in a standard flask with water. Pipette out 10 ml of this solution into a 100 ml standard flask and make up to the volume with water.

A-3.2.3.3 *Measurement of absorbance* — Pipette out 20 ml of standard and sample Titanium solution into two separate 50 ml of 3 percent hydrogen peroxide solution and make up to the volume with water. Take the absorbance of this standard and sample solution in a UV Spectrophotometer at 410 nm after correcting the blank to zero absorbance. (Blank is to be prepared omitting sample).

A-3.2.4 *Calculation*

$$\text{Titanium Dioxide as TiO2, percent by mass} = \frac{A_1 \times M_2 \times 100}{A_2 \times M_1}$$

where

A_1 = blank corrected sample absorbance,

A_2 = blank corrected standard absorbance,

M_1 = mass of sample taken in g, and

M_2 = mass of standard titanium dioxide taken.

(PCD 19)

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